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[AU/AU]; 546 Station Street, North Carlton, VIC 3054 (AU).

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(74) Agent: FREEHILLS CARTER SMITH & BEADLE;  
101 Collins Street, Melbourne, VIC 3000 (AU).

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(71) Applicant (*for all designated States except US*): SECURENCY PTY LTD. [AU/AU]; Hume Highway, Craigieburn, VIC 3064 (AU).

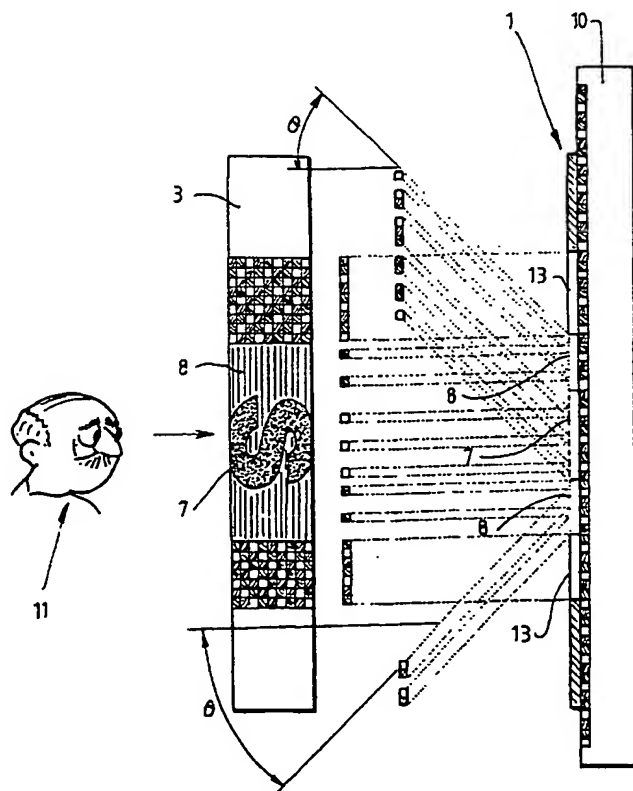
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(72) Inventor; and

(75) Inventor/Applicant (*for US only*): ZIENTEK, Paul

[Continued on next page]

(54) Title: SECURITY ARTICLE INCLUDING DIFFRACTIVE OPTIC FILTER



(57) Abstract: A security article such as banknotes, credit cards, passports, security passes, etc. comprising a transparent plastics substrate (2) bearing a diffractive optic filter (6) comprising at least a first zone (7) and second zone (8), with first and second diffractive structures or gratings formed in each zone. The first diffractive structure being operative to discriminatingly project a first selected colour at a first selected colour at a viewing angle by diffracting at least a first spectral component (e.g. red and green) of polychromatic light transmitted through said first zone by at least an angle  $\theta$  from said viewing angle, said first colour forming at least part of a projected security image when said diffractive optic filter is viewed at said viewing angle.

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## SECURITY ARTICLE INCLUDING DIFFRACTIVE OPTIC FILTER

The present invention relates generally to devices for authenticating various items which are subject to counterfeiting, and in particular to authenticating devices of this type which act to diffract incident light. The invention is suitable for use  
5 with banknotes and other security documents such as credit cards, passports, security passes, etc., and it will be convenient to hereinafter describe the invention in relation to that exemplary application. It is to be appreciated, however, that the invention is not limited to use in this application.

A wide variety of security devices or features for security documents, such as  
10 banknotes, travellers' cheques or the like have been proposed previously. Examples of such security devices and features include optically variable devices such as holograms and diffraction gratings, security threads or strips, micro-print, fine line or "filigree" patterns, moire inducing patterns and optically variable inks.

However, recently considerable advances have been made in photocopying  
15 and like machines for the colour reproduction of documents. The advances in such machines, and in the technology associated with like equipment enabling the reproduction of banknotes and other security documents, increasingly diminishes the effectiveness of known security devices.

Accordingly, there is a need to provide security devices or features for  
20 incorporation in security articles or documents of increasing sophistication in order to make unauthorised reproduction of such objects increasingly difficult.

With this in mind the present invention provides a security article comprising a transparent substrate bearing a diffractive optic filter comprising at least a first zone, wherein a first diffractive structure is formed in said first zone, said first  
25 diffractive structure being operative to discriminatingly project a first selected colour at a viewing angle by diffracting at least a first spectral component of polychromatic light transmitted through said first zone by at least an angle  $\theta$  from said viewing angle, said first colour forming at least part of a projected security image when said diffractive optic filter is viewed at said viewing angle.

30 Preferably, the diffractive optic filter further comprises at least a second zone adjacent said first zone, and a second diffractive structure is formed in the second

zone, said second diffractive structure being operative to discriminatingly project a second selected colour, visually discernible from the first selected colour, at said viewing angle by diffracting at least a second spectral component of polychromatic light transmitted through said second zone by at least said angle  $\theta$  from said viewing angle, said first and second colours together forming at least part of said projected security image.

In one embodiment, the substrate is formed of transparent plastics material. The transparent plastic substrate may comprise at least one film of transparent polymeric material.

10 An opacifying layer may be applied to at least a first surface of a substrate, said opacifying layer only partly covering said first surface of the substrate to leave at least said diffractive optic filter essentially uncovered. The substrate may include an uncovered region at least partially surrounding said diffractive optic filter.

The security article may be a security document, such as a banknote.

15 The following description refers in more detail to the various features of the present invention. To facilitate an understanding of the invention, reference is made in the description to the accompanying drawings where the security article is illustrated in a preferred embodiment. It is to be understood that the security article of the present invention is not, however, limited to that preferred embodiment.

20 In the drawings:

Figure 1 is a plan view of a banknote in accordance with one embodiment of the invention;

Figure 2 is a schematic diagram illustrating the operation of the diffractive optic filter of the banknote of Figure 1 in the presence of incident polychromatic light; and

25 Figure 3 is a schematic diagram illustrating the projection of a security image by the diffractive optic filter of the banknote of Figure 1.

Referring now to Figure 1, there is shown generally a banknote 1, being one example of a security article according to the present invention. The banknote 1 has a substantially planar structure and comprises a flexible sheet-like substrate 2 of transparent plastics material. The substrate 2 is covered over most of its upper and

lower surfaces by opacifying layers 3 and 4. As shown in Figure 1, the opacifying layers are not applied over the entire surfaces of the sheet-like substrate 2, and thus leave a transparent portion 5 of the substrate which is at least partially uncovered by the opacifying layers 3 and 4. This transparent, essentially uncovered portion 5 constitutes a "window" in the banknote through which light may be transmitted.

The substrate 2 of transparent plastics material is preferably formed from a transparent polymeric material which may be made from at least one biaxially oriented film. The substrate may comprise a single layer film of polymeric material. Alternatively, the substrate may comprise a laminate of two or more layers of transparent biaxially oriented polymeric film.

The opacifying layers 3 and 4 may comprise in one or more of a variety of opacifying inks which can be used in the printing of banknotes or security documents. For example, the layers of opacifying ink may comprise pigmented coatings comprising a pigment, such as titanium dioxide dispersed within a binder or carrier of heat activated cross-linkable polymeric material. Alternatively, a substrate of transparent plastics material 2 may be sandwiched between opacifying layers of paper to which indicia is printed or otherwise applied.

Whilst the banknote in Figure 1 is shown as having opacifying layers applied to both upper and lower surfaces, in other embodiments of the invention, only one of the surfaces of the banknote may have an opacifying layer applied thereto.

According to the present invention, the transparent substrate 2 bears a diffractive optic filter 6. The diffractive optic filter may be incorporated into the surface of the substrate 2, or may be formed within a transfer foil structure that is later applied to the substrate 2. The diffractive optic filter comprises a first zone 7, and, in this example, at least a second zone 8. A diffractive structure is formed in each of the first and second zones 7 and 8. More specifically, each region incorporates a transmissive diffractive structure, such as a diffraction grating, formed as a microscopic 3-D relief pattern. The grating structures of both the first diffractive structure formed in the first zone 7 and the second diffractive structure formed in the second zone 8 have profiles and line spacings, or a periodicity, chosen so as to diffract at least a first spectral component of polychromatic light transmitted

through the transmissive diffractive structure by a given angle  $\theta$ . The characteristics of each of the diffractive structures in the two zones 7 and 8 are chosen so that different spectral components of the polychromatic light transmitted by each through the window in the banknote 1 are diffracted, so that the remaining  
5 undiffracted spectral component projected by each of the diffractive structures produces visually discernible colours which together form a projected security image.

The characteristics of each of the diffractive structures in the first and second zones 7 and 8, such as the line spacing, profile and depth of the grating structure,  
10 may be chosen to precisely define that spectral component of the polychromatic light which is to be diffracted.

Whilst the embodiment of the security article shown in Figure 1 includes a diffractive optic filter having two zones, each of which includes a different diffractive structure, in other embodiments of the invention only one such zone  
15 having a single diffractive structure may be used. Similarly, three or more zones, each having a separate diffractive structure, may be incorporated in other embodiments.

Figures 2 and 3 shown one example in which the authenticity of the banknote 1 may be verified by a user. As seen in Figure 2, a user may place the banknote 1  
20 directly in front of an appropriate polychromatic light source. For example, the banknote 1, containing the diffractive optic filter in the clear window 5 thereof, may be placed against a video display terminal (VDT) screen 10. The VDT screen contains an array of red, green and blue (RGB) pixels, which respectively transmit a red, green and blue spectral component of the polychromatic light emitted from the  
25 screen.

In other embodiments, a different polychromatic light source may be used, such as a broad flat white light source such as a fluorescent light box. Preferably the light source used will cover an area which is larger than the area of the diffractive optic filter, and will produce light that can be separated into at least two  
30 spectral components.

The banknote 1 itself may also act as the polychromatic light source. For example, the banknote 1 may be folded so that a multi-coloured surface is superposed with the clear window 5. Ambient light may then be reflected from the multi-coloured surface of the banknote 1 and transmitted through the diffractive optic filter 6 in the clear window 5.

In the configuration shown in Figure 2, the light emanating from the light source 10 passes outwards towards a user 11 situated at a viewing angle from the banknote 1, in this case perpendicular to the plane of the banknote.

In this example, the first diffractive structure formed in the first zone 7 of the diffractive optic filter 5 acts to diffract the red and green spectral components of the polychromatic light transmitted through the substrate 2 of the banknote 1, and then through the first zone 7. The characteristics of the first diffractive structure are chosen such that the red and green spectral components are diverted by at least an angle  $\theta$  similarly, the second diffractive structure formed in the second zone 8 of the diffractive optic filter 6 acts to diffract the green and blue spectral components of the polychromatic light emitted from the VDT screen 10 by at least the angle  $\theta$ .

Accordingly, only the blue spectral component of the light emitted from the VDT screen is transmitted to the user 11 through the first zone 7, whilst only the red spectral component of the polychromatic from the VDT screen 10 is transmitted by the second zone 8 to the user 11.

The colours transmitted by each of the zones of the diffractive optic filter 6 may be chosen so that each transmits a colour which is visually discernible from the colours in each of the other zones. In this way, the colours from the various zones of the diffractive optic filter combine to form at least part of a projected security (schematically represented in Figures 1, 2 and 3 in the form of an "S").

As may be best appreciated from Figure 3, the angle  $\theta$  by which the different spectral components of polychromatic light are diffracted by each of the first and second diffractive structures, should be chosen so that the diffracted spectral components are diverted outside of the users field of view 12.

Referring again to Figure 1, an uncovered zone 13 may be left around at least part of the diffractive optic filter 6 in the window 5, this uncovered portion 13

allowing all spectral components of the polychromatic light emitted from VDT screen 10 to be transmitted to the user 11. This enables the user 11 to more easily distinguish between the unfiltered light transmitted through the uncovered portion 13 and that transmitted through the diffractive optic filter 6.

- 5        Many other variations may be made to the above described embodiment without departing from the spirit or ambit of the invention.



## CLAIMS

1. A security article comprising a transparent substrate bearing a diffractive optic filter comprising at least a first zone, wherein a first diffractive structure is formed in said first zone, said first diffractive structure being operative to  
5 discriminatingly project a first selected colour at a viewing angle by diffracting at least a first spectral component of polychromatic light transmitted through said first zone by at least an angle  $\theta$  from said viewing angle, said first colour forming at least part of a projected security image when said diffractive optic filter is viewed at said viewing angle.
- 10 2. A security article according to claim 1, wherein the diffractive optic filter further comprises at least a second zone adjacent said first zone, and a second diffractive structure is formed in the second zone, said second diffractive structure being operative to discriminatingly project a second selected colour, visually  
15 discernible from the first selected colour, at said viewing angle by diffracting at least a second spectral component of polychromatic light transmitted through said second zone by at least said angle  $\theta$  from said viewing angle, said first and second colours together forming at least part of said projected security image.
- 20 3. A security article according to either of claims 1 or 2, wherein the substrate is formed of transparent plastics material.
4. A security article according to claim 3, wherein the transparent plastic substrate comprises at least one film of transparent polymeric material.
- 25 5. A security article according to any one of the preceding claims, and further comprising an opacifying layer applied to at least a first surface of a substrate, said opacifying layer only partly covering said first surface of the substrate to leave at least said diffractive optic filter essentially uncovered.

6. A security article according to claim 5, wherein the substrate includes an uncovered region at least partially surrounding said diffractive optic filter.
7. A security article according to any one of the preceding claims, wherein said  
5 security article is a security document, such as a banknote.

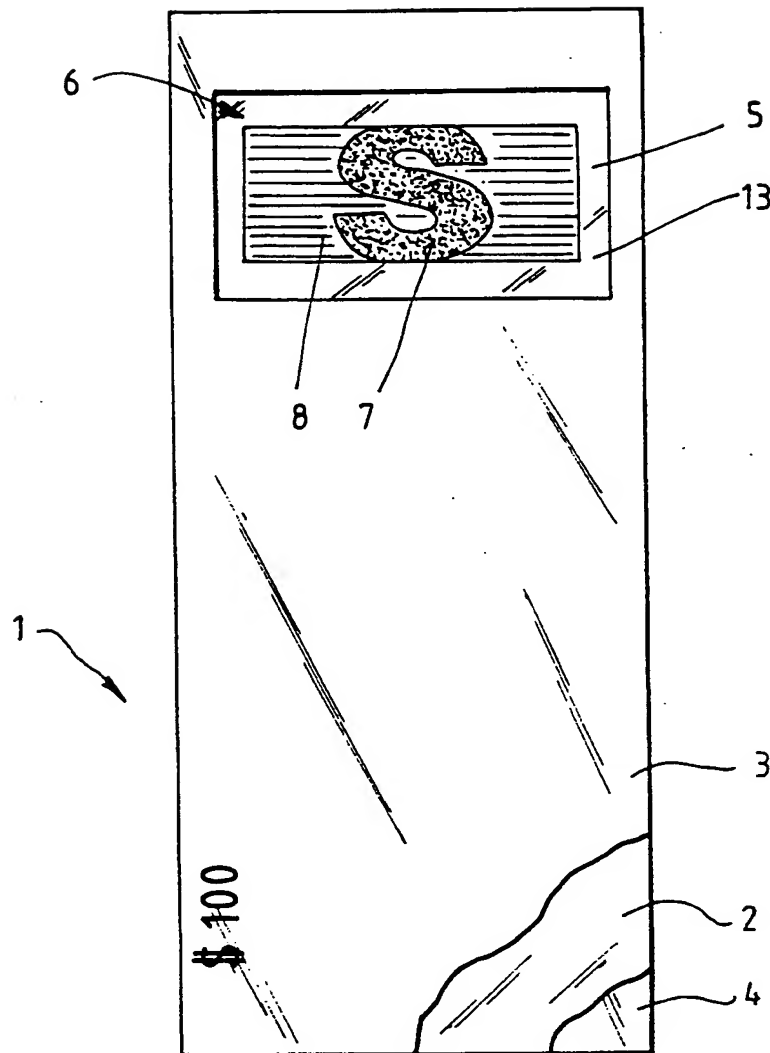


FIG. 1.

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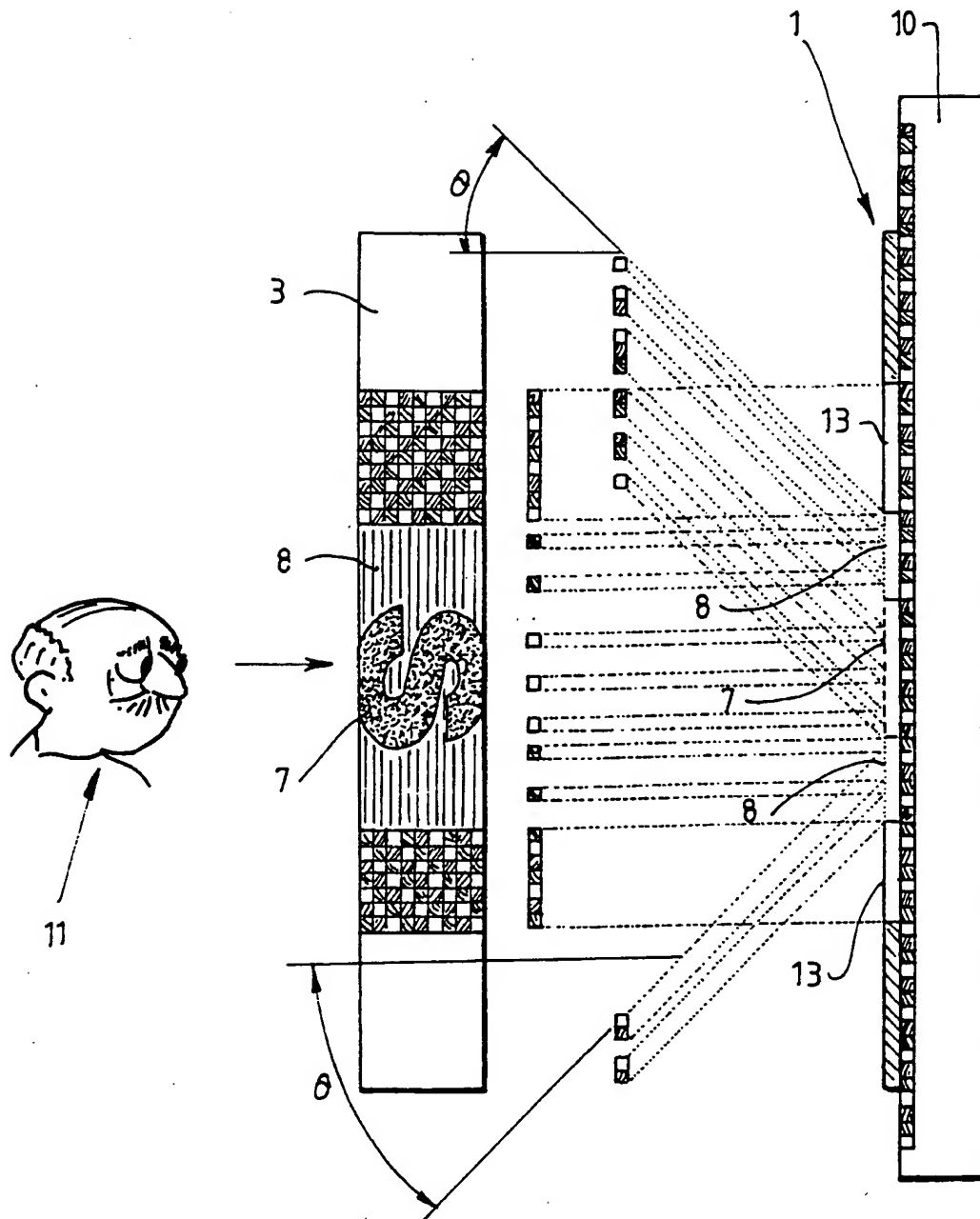
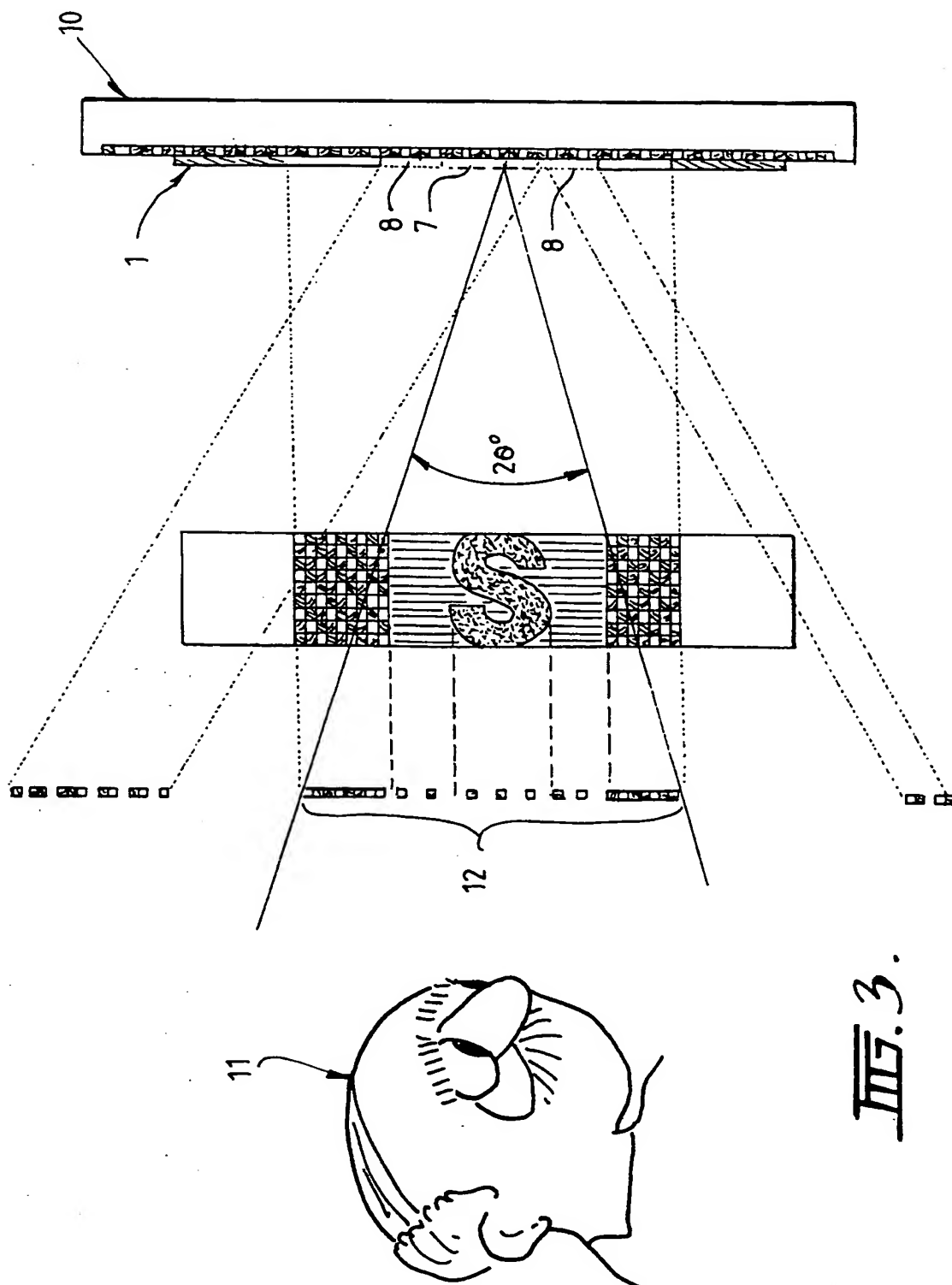


FIG. 2.

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III.3.

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## INTERNATIONAL SEARCH REPORT

International application No.  
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**A. CLASSIFICATION OF SUBJECT MATTER**

Int. Cl. <sup>7</sup>: B44F 1/12, G02B 5/18, 27/42, B42D 15/10 // B42D 101:00, B42D 209:00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC B44F 1/12, G02B 5/18, 27/42, B42D 15/10, 101:00, 209:00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
AU: B44F 1/12, G02B 5/18, 27/42

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
WPAT

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2296785 A (DEBDEN SECURITY PRINTING LTD) 10 July 1996 Whole document - page 5, line 18 to page 6, line 10	1-7
X	Derwent Abstract Accession No. 95-231435/30, Class P76 WO 95/16574 A (KURZ GMBH & CO LEONARD) 22 June 1995 Abstract and figures	1-7
X	WO 98/23979 A (COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION) 4 June 1998 Whole document	1-7

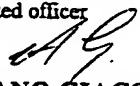
☒ Further documents are listed in the continuation of Box C ☒ See patent family annex

- \* Special categories of cited documents:
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Date of the actual completion of the international search  
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Name and mailing address of the ISA/AU  
AUSTRALIAN PATENT OFFICE  
PO BOX 200, WODEN ACT 2606, AUSTRALIA  
E-mail address: pct@ipaustalia.gov.au  
Facsimile No. (02) 6285 3929

Authorized officer  
  
ADRIANO GIACOBETTI  
Telephone No : (02) 6283 2579

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/00723

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5876068 A (SCHNEIDER et al) 2 March 1999 Whole document	1-7
X	WO 83/00659 A (COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION) 3 March 1983 Whole document	1-7

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
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This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report				Patent Family Member			
GB	2296785	GB	2296784	WO	96/21572		
WO	95/16574	AU	11051/95	DE	4343387		
WO	98/23979	AU	50414/98				
US	5876068	EP	330733	WO	89/08166	DE	3906695
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		IT	1152046	NL	8220285	NZ	201691
		US	4536016	SE	8305110		
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